

ROYAL ASTRONOMICAL SOCIETY.

VOL. XII.

January 9, 1852.

No. 3.

J. C. ADAMS, Esq., President, in the Chair.

Hugh Lee Pattinson, Esq., Newcastle-on-Tyne;

Rev. Thos. Wm. Webb, Granarew, near Monmouth;

Wm. Johnson, Esq., Thame;

Edward Hughes, Esq., Greenwich Hospital School;

George Henry Strutt, Esq., Melford House, Derby;

Colonel Lloyd, Surveyor-general of the Mauritius,
were balloted for and duly elected Fellows of the Society.

Solar Eclipse of July 28, 1851.

In the present *Monthly Notice*, the Editor has attempted to include the principal *astronomical* phenomena which were observed during the solar eclipse of July 28, 1851, and of which accounts were sent to the Society. It is the intention of the Council to publish these memoirs at length in the 4to. volume; but so much interest has been taken in certain peculiarities attending this eclipse, that an earlier, though very partial, publication, has been deemed expedient.

In the total eclipse of 1842, observed by MM. Baily and Airy in the north of Italy, certain rose-coloured mountains were observed upon the limb of the moon, which are well expressed by the plates illustrating the memoirs of those gentlemen (see *Mem. R. A. Soc.*, Vol. xv., pp. 1, 18, plates I. and II.) These prominences are sufficiently described by calling them conical, and, perhaps, on the whole, of greater height than breadth.

In the recent eclipse several of these conical prominences were seen; and many of the sketches made by the different observers may be sufficiently reproduced, with a little attention, from *description*.

Some observers denote a situation on the moon by the angle measured along the circumference of the moon, from the north point of sun to the object. The reader, therefore, to comprehend the description, must draw a circle, graduate it to 360° , and then at the angle mentioned, erect and colour the prominence according to the text. If the division 0° be at the top, the appearances will be as if seen by the naked eye, with the *west* or *preceding* on the right hand, and the *east* or *following* on the left. If this figure be turned upside down, the appearance will be that seen in an astronomical telescope. (See Mr. Dawes' sketch in the accompanying plate).

Again, if a point somewhere about 30° or 35° be taken to the east of the north, this will be tolerably near the *vertex* or upper limb of the sun. Some of the observers refer the places of the prominences by angles measured from the *vertex* to the east or west. If the vertex be placed below, the appearances are such as would be seen in an inverting telescope. In the plate the appearances are figured in their natural position, as seen by the naked eye.

The eclipse commenced on the west side of the sun, and finished on the east. Generally, the disappearance took place in the east, and the reappearance on the west.*

The figure which represents the total eclipse, is taken from a sketch by Mr. Dawes, which included rather more than any other which has come into the Editor's hands. It is not to be considered as the state of the eclipse *at any one time*, but as containing all the appearances which were seen during the eclipse at any time, and at their respective *maxima*.

Mr. Hind's drawing is in all essentials precisely similar to Mr. Dawes', except that the southern *sierra* is continuous in Mr. Hind's, and interrupted in Mr. Dawes's sketch. Mr. Airy saw the western, but not the eastern portion of this *sierra*. It does not seem to have been distinctly recognised by any other observer.

The *conical* prominences, and even the prominences with two summits, may easily be drawn in their proper places by description, and by the figures in the *Memoirs* of MM. Baily and Airy, already referred to, or by Mr. Dawes' sketch; but the peculiar appearance of one prominence has been remarked by every observer, though there is a considerable difference in their descriptions and sketches. An attempt has been made to represent this appearance in the fifteen figures which are given in the bottom of the plate, and which are all intended by their authors to be portraits of the same individual. Conceiving these to be detached and applied to the limb of the moon at the angles assigned by the observers, it will not be difficult to create a tolerable picture of the eclipse as seen by each person.

In figuring the corona there is much greater discrepancy than in describing it: no attempt has been made to give any idea of this accompaniment beyond the words of the beholders. The description of the phenomena of Baily's beads must be looked for in Mr. Baily's paper, *Mem. R. Ast. Soc.*, vol. x., plate I.†

The physical and picturesque observations have been very briefly noticed, as they will appear in the quarto volume, and would have extended this *Notice* beyond due bounds. At the Island of Bue, the Norse fishermen showed great terror; at Trollhättan Falls, the observers within doors were almost scandalised by the uproar of those without; at Göttenburg, all sounds of labour ceased during

* As the publication is intended for many persons who are *not familiar* with astronomy, this very rudimental information may have its use.

† Figures 1, 2, and 3 of this plate were seen by several observers on the present occasion, but not the distortion of the moon's limb, as in fig. 4.

the darkness; and not far from Christiania, Lieut. Krag observed an old woman, who merely lighted her candle and continued her work. At Lilla Edet, people seem to have put on their best clothes.

Among animals,—dogs, horses, and cows, seem to have felt a little surprise, but not so much as to divert their attention from food: a calf formed some exception to this rule. The wild birds, which were surprised by the sudden darkness, seemed utterly at a loss, and were distressed, while the domestic fowls treated it as they would have done a natural close of one day and the beginning of another. Flowers showed the night phenomena.

There are two remarks, in which *all* the observers agree; first, in the strangeness, grandeur, and impressiveness of the spectacle; all express their gratification with the sight, and think they were repaid for their trouble: secondly, all return thanks for the hearty and kind manner in which they have been received by Dane, Swede, and Norseman. Professor Hansteen and Mr. Crowe at Christiania, Mr. Mygind at Lilla Edet, Lieut. Pettersson at Göttenburg, and Colonel Silverstopfe at Christianstadt, are gratefully and particularly thanked for their assistance and countenance.

The angles are sometimes stated by the observers, sometimes guessed by the Editor from the sketches. Mr. Swan's, and probably Mr. Dawes' angles, may be considered as more accurate than the rest. The observations follow in geographical order, from which it was hoped that something might be elicited. The consideration of most importance seems to be the parts of the moon's limb at which the sun disappeared and reappeared.

Island of BUE.

Latitude, $61^{\circ} 9' 42''$ N.; Longitude, $0^{\text{h}} 17^{\text{m}} 24^{\text{s}}$ E.

Observations by Professor P. Smyth.

These observations were made in company with Dr. Robinson and several other gentlemen. The Commissioners of Northern Lights allowed their steamer to make a *detour* from their periodical visitation of the Shetland lighthouses; and the officers of the ship, and the scientific gentlemen who embarked for the purpose of observing the eclipse, were fully equipped with telescopes, chronometers, &c. from the stores of the Admiralty and from the observatories of Armagh and Edinburgh.

The steam-boat reached her point of destination (the island of Bue, which is the outermost of the series which line the Norwegian coast, and about 60 miles north of Bergen) on the morning of the day of the eclipse. Sights for time were got by sextant and artificial horizon about 10 A.M., and about noon for latitude. As the rate and error of the chronometer had been obtained at the Edinburgh observatory, the longitude and latitude above given were deduced from the sextant observations.

The clouds which covered the sun more or less during the eclipse prevented an accurate observation of the commencement of the

eclipse: the totality was apparently well observed, but it will be seen that there is a startling difference between the observers.

	Local Time.			Greenwich Time.			Observer.
	h	m	s	h	m	s	
Commencement ...	2	11	57	1	54	13	Prof. P. Smyth, too late.
Totality	3	12	37	2	55	13	} Dr. Robinson.*
—	3	12	42	2	55	18	
—	3	14	33	2	57	9	Prof. P. Smyth.

The clouds now came on so thick that no further observation could be made.

After Dr. Robinson's signals were given, Professor Smyth continued to see the sun's crescent of a very visible breadth and well defined, but faint through clouds; at Dr. Robinson's signals sudden *depressions* in the *brightness* of the surface were perceived, and when Professor Smyth himself gave the signal for the totality, the limb seemed to vanish at once, though it had still a sensible breadth and was well defined.

"These variations may have been caused by passing clouds;" but Professor Smyth is inclined to think, "from their instantaneity, that they were produced by variations in the solar light itself, and that these variations were rendered more sensible, as the sun was almost obscured by a thick cloud." The Astronomer Royal accounts for his having seen the commencement of the totality of the eclipse of 1842 twice over, from the different specific brightness of the body of the sun and his extreme edge.† If we consider the cause of the difference to be in the cloud, though the observers used telescopes of the same aperture, Dr. Robinson had a power of 120 and Professor Smyth one of only 48, and Dr. Robinson's stand was somewhat rickety, while the Professor's was very firm, and loaded with heavy weights to keep it steady.‡ Indeed, from the visible and well-defined breadth of the strip of the sun at the moment of totality, as noted by himself, Professor Smyth has no doubt that the phenomenon would have occurred later, if the atmosphere had been clear or the telescope a more powerful grasper of light.

Thermometrical observations were made, but from the state of the sky cannot be considered of much value. There was a break in the north horizon, through which snow mountains were seen, probably 100 miles off.

The atmospheric appearances have been very strikingly exhibited by Professor Smyth in six water-colour drawings, which he had the kindness to exhibit at the December meeting.

Though the impression of darkness on the senses was that of something darker than an ordinary night, yet it was not, after all,

* Dr. Robinson gave a signal at the time first noted, and a second signal about 5^s later, which was not noted at the moment when given.

† See *Mem. Royal Ast. Soc.*, vol. xv. pp. 11, 13.

‡ It is clear that a faint object might thus be lost by one observer while visible to the other, and if dark glasses were used, incautiously, this might still more easily happen.

so very intense. Small print could be read, and the marks of a pencil in sketching seen.

The colours in the sky somewhat resembled those which may at times be seen in stormy weather on an autumnal evening, half an hour after sunset.

CHRISTIANIA.

Latitude, $59^{\circ} 54' 5''$ N.; Longitude, $14^{\text{h}} 42^{\text{m}} 53^{\text{s}}.9$ E., *Naut. Alm.*

Observations by Mr. Dunkin.

Mr. Dunkin, one of the assistants at the Royal Observatory, was, at Mr. Airy's request, directed by the Lords Commissioners to observe the eclipse. The station of Christiania was chosen by Mr. Airy as being on the west of the central passage, he himself observing that phase at Göttenburg. The telescope used by Mr. Dunkin is of $3\frac{1}{2}$ inches aperture and about 3 feet focal length, power 38, mounted on a firm tripod stand with steadying-rods. A chronometer by Dent, belonging to the observatory of Christiania, was employed for the time. There were two parallel wires in the eye-piece at 1' distance. These wires were placed horizontally during the eclipse. The place of observation was in Mr. Crowe's garden, not far from the observatory, and was pretty open except to the north.

First External Contact, $2^{\text{h}} 41^{\text{m}} 48^{\text{s}}$, by Chronometer.*

Ten minutes before totality the darkness was becoming evident; at five minutes before totality Mr. Dunkin took off the dark glass, as the sun's light was faint enough to be borne without fatigue.

As the totality approached, no mountains were seen on the moon's limb, nor was any part of her limb visible *beyond* the sun.

"About fifteen seconds before the beginning of total darkness, the narrow line of the sun broke up into numerous small particles or beads of light. They were of different sizes, some being merely points, while others appeared more elongated; their appearance was of intense brilliancy, and the only thing they can be compared with is a necklace of diamonds. These beads were perfectly steady; their only change being their gradual disappearance as the total obscuration of the sun approached. The time noted for the beginning of total darkness was when the last spot of light was lost."

Beginning of Totality	$3^{\text{h}} 44^{\text{m}} 49^{\text{s}}.5$	by Chronometer.
End	$3^{\text{h}} 47^{\text{m}} 24^{\text{s}}.0$	—

Little appearance of the corona was seen, and no trace whatever of polarization: green was as bright as any other colour.

"Twenty seconds after the totality had commenced, a small cloud quite obscured the sun for a short time. When this had passed over, the red prominences were sought for. Of these, three were seen. The first was at an angle of 70° from the vertex

* The chronometer was $1^{\text{m}} 58^{\text{s}}.2$ slow on Christiania mean time.

towards the west; the second was at an angle of 100° ; and the third at an angle of 145° . The last-mentioned was most curiously formed, having something of a horned shape; it was curved in the direction of the lower part of the field. Its height was about $1' 30''$, the breadth at the base $30''$. It had a most remarkable appearance, and it was carefully watched to see if any change took place in its size (see figure 15). My eye was intently fixed upon it for about a minute of time, and during that interval, not the slightest change took place in its form. Its colour was pink, or rose colour, but the shade was not very deep. It seemed to me at the time, from the excessive steadiness of this prominence, and from the fact that I had zealously watched it for so long an interval without its undergoing any change, that this object had some connexion with the moon. However, as my observations have been all made under rather difficult circumstances, it is possible I may be deceived. With the doubly refracting prism, I could not perceive any difference in the brightness of the images of this prominence. The other two prominences were precisely similar to each other in size, their height being about $40''$ and their breadth at the base $30''$, and tapering to a point at the apex; these also remained perfectly stationary during the last minute of total darkness. As soon as the first ray of light from the sun appeared, they all disappeared instantaneously; I could not perceive the slightest trace of them after the formation of the beads on the reappearance of the sun. This second display of Baily's beads was again seen in all its beauty."

There was no distortion of the limbs of sun or moon. Clouds covered all up soon after the reappearance of the sun.

The darkness during the totality was very great, far beyond what was anticipated. The title-page of the "Suggestions" was read with difficulty at a distance of 10 or 12 inches, yet the outlines of mountains, at least 15 miles off, were faintly visible.

Lieut. Krag, who had undertaken to read the chronometer, was unfortunately called off upon duty, and Mr. Bennett, a student in the university, undertook the office without the necessary preparation. It is, therefore, not impossible that some error may have crept in. The wind was so high that Mr. Dunkin could not hear the beats.

Mr. Dunkin made a careful series of comparisons of the black bulb and free thermometer, but the results are rendered a little irregular by clouds.

Observations by Mr. Snow at the Observatory.

The telescope was a refractor by Dollond, 45 inches focal length, $2\frac{1}{2}$ aperture, power 35, mounted on a pillar and claw-stand with an adjustable equatoreal block set to the latitude of the place; the whole supported on a solid stone pillar in the garden of the observatory.

First External Contact $2^{\text{h}} 43^{\text{m}} 38^{\text{s}}$ Christiania M.T.*

* The observations were made with a good pocket watch, and this was compared before and after the eclipse with the Christiania transit clock.

The limb of the sun seemed to Mr. Snow rather better defined than the limb of the moon, though no lunar mountains were made out with any certainty.

“When the totality approached, the disappearance of the sun began to take place by the breaking up of the extremities of the horns into detached morsels of light, scarcely to be called bead-like, as they were not round nor quite steady, but slightly waving and undulating towards the points of the horns.”

Beginning of Totality	3	46	53	Christiania M.T.
End	—	—	3 49 28	— —

“The corona was visible through a pretty thick cloud. It appeared not to be uniformly disposed, but in irregularly radiating bundles or masses.” At the same time, four very bright, unequal, and not well-defined prominences, made their appearance: one shaped like a horn turned downward at about 125° from the vertex towards the west” (this was seen by all the observers, figure 14 like Mr. Snow’s sketch); another at 70° west from the vertex; a third at 40° west from the vertex; and a fourth at 30° east from the same point.* The first-mentioned prominence was considerably larger than the others, but all were pretty equal in intrinsic brightness. “There was that about the large prominence which made me suspect that if I had seen it in a clear sky, it would have been filamentous at the extremity.” The fourth prominence was marked on the paper as having two summits, but the recollection of it was less perfect than of the rest.

“The phenomena of the total disappearance were viewed through a pale blue eye-shade, which threw a grey tint over the whole.” Mr. Snow remarks the similarity of position between the “horn” and a spot going off, and also between a pretty large spot, coming on, and the fourth prominence, which he believes he saw. “When the total darkness took place, it was not easy to decipher the figures of a watch held in the hand, and yet the distant hills were very visible.”

RINGERIGEL, not far from CHRISTIANIA.

Observations by Lieut. Krag.

Lieut. Krag had intended to assist Mr. Dunkin, but was called away by his military duties. Having provided himself with a telescope and dark glasses, he found the opportunity to place himself at a station which commanded an extensive view of nearly 40 miles round.

In the early part of the eclipse, there was a great deal of interruption from clouds, but when the phase was of 11 digits, the sky became pretty clear, and kept so. Lieut. Krag, “on the approach of total darkness, clearly saw the shadow travelling across the country, and gradually increasing until at its height.” During the

* These angles, when not specified by the authors, are *guessed*, from their sketches: they here refer to the position as seen by the naked eye.

totality, "the observations with the telescope were continued, and the reflexion from the earth was so powerful that the moon appeared almost the same as when seen by daylight at the same time with the sun."

"The moon's edge was surrounded by a perfect shining white border, the corona; and outside this, a narrow light violet stripe was observed."

It was not so dark as was anticipated. Lieut. Krag was able to read a book and distinguish, though faintly, the outlines of distant mountains.

Two flame-shaped prominences were seen on the edge of the moon with the telescope during the totality. The colour was a little redder than the light of the cotton taper with spirits used for lighting gas-lamps. These were not visible to the naked eye.

On the right, the horizon was lighted by the sun's returning beams and gradually became brighter and brighter. This was probably owing to the reflexion from clouds. While the right was thus illuminated, the left at the distance of 14 miles lay for a short time covered in shadow.

The wind fell a little before the totality, and rose very soon after.

The barometer was not affected; the thermometer fell 4° , but rose after.

DRÖBAK, about 19 miles S. by W. of CHRISTIANIA.

Latitude, $59^{\circ} 40'$ N.; Longitude, $0^{\text{h}} 42^{\text{m}} 30^{\text{s}}$ E. (by Map).

Observations by Capt. Biddulph, R.A.

This station had a very extensive horizon, and Capt. Biddulph attended principally to the picturesque effect of the eclipse. During the whole of the phenomenon the sun was obscured by so much cloud that a dark glass was occasionally unnecessary. Up to the time when the sun was three quarters covered, the light was not strikingly diminished, but a dull grey colour was cast over the landscape. As it became apparent that the sky would not allow of an observation of the totality, Capt. Biddulph laid his telescope aside, and looked for the effects of the coming shadow. "It was best appreciated by the sensation of darkness coming over one as a thick dark atmosphere, spreading itself over sky and land to the N.W., and more distinctly on the clouded sky overhead. At last the light was extinguished like a candle, the red roof of a house (which had been particularly noticed) was gone, and the horizon no longer visible. On looking up, the last bright ray of the sun had been covered, and only a faint trace of the corona could be seen through the mist. The rapidity of the motion of the shadow produced a feeling that something material was sweeping over the earth at a speed perfectly frightful. I involuntarily listened for the rushing sound of a mighty wind."

The time the sun was covered was about $3\frac{1}{2}$ minutes. The light was of a deep blue purple. In a group of blue and yellow

flowers and red strawberries, the blue was reflected, the red and yellow were not, yet the crimson purple blossoms of the clover were distinguishable.

Capt. Biddulph estimated the darkness to be more intense than that of the midnight preceding.

FYLDPA, 40 miles S.S.W. of CHRISTIANIA, 4 miles W. of
TONSBURGH.

Latitude, $59^{\circ} 20' N.$; Longitude, $0^h 41^m 20^s E.$ (by Map).

Mr. Jackson and Mr. King observed at Fyldpaa, Mr. Jackson had a small hand telescope, Mr. King an astronomical telescope with a power of 40.

No appearance of the *beads* was seen at the totality; but one speck of light seemed to hang on the moon's disc, like a star previous to occultation.

After the totality had commenced, Mr. Jackson saw three red prominences. One at about 70° from the vertex to the west; another at 110° to the west (this is the hook-formed prominence seen by everybody); and a third at 140° to the west. On a second view, a little before the sun reappeared, a fourth prominence showed itself at about 45° from the vertex towards the west, and the other prominences, especially the hook-shaped one, were elongated. In Mr. Jackson's drawing (see fig. 14) it has the curvature gradual and the end is taper like a horn. Immediately afterwards, a pale red tinge passed over the lower edges of the moon, followed by a mingled light of pale colours, when, in an instant, the sun shone forth, and the red prominences disappeared. The beads were seen in the larger telescope by Mr. King, but not by Mr. Jackson with the smaller.

JUNE, near SARPSBORG.

Latitude, $59^{\circ} 14' N.$; Long. $44^m 18^s E.$ approx.

Observations by Mr. Gray.

The station was an eminence near the church of June. The telescope was $3\frac{3}{8}$ inches aperture, focal length 53 inches, and power 60. At the commencement the sky was covered, but when the moon was half advanced on the sun's disk, the irregularities on her limb were well defined. The observations of totality were not very satisfactorily noted, as the attention of the observer was partially withdrawn from the telescope to other observations. The duration was about $3^m 10^s$.

Just before totality the sun's limb broke into numerous irregular beads of light.

The corona, seen by the naked eye, appeared a ring of white light in the clouds, its breadth being about equal the moon's radius; gradually fading away, without radiations.

Mr. Gray saw four red prominences, the position of which he estimates to be as follows:—

1, on the West side at	15° South of the parallel of declination.		
2, on the East	5° North	—	—
3, on the West	30° North	—	—
4, on the West	60° North	—	—

But the parallel of declination is only roughly estimated.

No. 1 at first appeared about $1\frac{1}{4}$ high and half the breadth, taper at the top; but as the eclipse advanced, it had apparently shot out as a gas-jet when fully turned on, and with a portion curved to the south; in this state it is fairly like Mr. Airy's sketch (see fig. 13). It was then fully $1\frac{3}{4}$ high. No. 2 was broader and fainter than 1, and its north end highest. The other two, about 1' high, were nearly square, and tuft-like, about 50" high, uneven in their outline, and indistinct at the base.

During the totality, the light seemed about the same as on the 2d August, in latitude 59° at $1\frac{1}{2}$ hours after sunset. The seconds on the chronometer were easily read; and the outline of the hills was distinctly visible.

The reappearance was preceded by a red light on the moon's limb, and the sun broke out at once in several beads.

FREDRICHSVAARN.

Latitude, 59° N.; Longitude, 40^m E. (by Map).

Observed by Mr. R. Stephenson.

The telescope employed was equatorially mounted, and had an aperture of $3\frac{3}{4}$ inches, power 35: it inverted. Capt. Andrews noted the time by his chronometer.

First External Contact	^h 1 ^m 51 ^s 30	Time by Chronometer.
Beginning of Totality	2 54 17	— —

The crescent of the sun, before disappearing, was gradually reduced to a fine thread of light, which broke up into fragments. In a second or two a rose-coloured flame shot out from the upper part of the moon's left limb, which in form resembled a sickle with the cutting edge uppermost (see fig. 14). This increased in size very rapidly, and then, other two rose-coloured prominences, one on the right and the other on the left, started out, neither of them so peculiar in shape, but evidently of the same character. These red prominences began as red specks, which almost immediately became summits by the extension below into bases.

The prominence which was sickle-shaped seemed illuminated at the back, while the edge seemed in shadow. Its estimated altitude was one-twentieth of the moon's diameter.

End of the Totality	^h 2 ^m 57 ^s 47	Time by Chronometer.
---------------------	--	----------------------

"The reappearance of the sun was remarkably instantaneous, presenting, not a fine line of light, as it had done in disappearing, but a series of spots of silver light, which suggested the idea of

globules of mercury rushing among each other along the edge of the moon." In two seconds the crescent formed and the rosy prominences disappeared.

The corona was a little irregular, and as if composed of separate diverging rays. The darkness was great, but a man could be distinguished at 70 or 80 yards; and it was light enough to see the sketch which was made of the moon and of the red appendages.

A thermometer on the grass fell from 70° to 58° .

The times are given according to a chronometer, which, from observations taken several days before, Capt. Andrews inferred to be $10^m 40^s$ slow on Greenwich M.T. Capt. Andrews took angular distances between the cusps during the advance of the moon on the sun.

Mr. Stephenson's sketch of the eclipse is not found with his paper, only a pencil outline of the sickle-shaped prominence.

TROLLHÄTTAN FALLS.

Latitude, $58^{\circ} 17' 30''$ N.; Longitude, $0^h 49^m 8^s$ E.

This position is near the celebrated Trollhättan Falls, about 40 miles north of Göttenburg. The observers, Messrs. Lassell, Williams, and Stanistreet, stationed themselves in different apartments of the hotel, the weather out-of-doors being very stormy and unpropitious.

Observations by Mr. Lassell.

Mr. Lassell used a telescope by Merz, of Munich, of 2.55 inches aperture, and 32.5 inches focal length, mounted on a rude but effective equatoreal stand. The eye-piece was a negative or inverting one, power 35. The sun became clear before the first contact, and its heat was so great that the dark glasses were broken with startling rapidity. The aperture was then limited to 2 inches, and the slide of dark glasses was heated over a candle until it was too hot to be touched. This succeeded, and the telescope was kept pointed to the sun, so that the dark glass could not get cool.

Two spots were noted. The estimated position of the preceding spot (a well-defined spot with three or four small dots near it), referred to a parallel of declination, was 288° , and of the following spot 90° , measuring from the north round by the east. The first contact was expected at an angle of position = 284° , and as Mr. Lassell kept his eye fixed on that point, and the sky was clear, he considers the observation very exact.

First Contact	^h 2 ^m 10 ^s 32	by the Watch; exact.
Spot Touched	2 12 36	— not good.

The southern limb of the moon had four or five well-defined summits, one more prominent and insulated than the others. "Some were more elevated, in proportion to their bases, than I remember to have seen on the moon's limb projected on the sky.

As the moon advanced, there did not appear to be any obvious difference of brightness in different parts of the sun. The cusps of the sun were in no degree distorted, even when not more than 50° or 60° of the sun's circumference apart."

"As the totality approached, which it seemed to do with amazing and fearful rapidity after the cusps embraced about 50° , I looked carefully for 'BAILY's beads,' as well as for any *drawing out* or osculation of the limbs about to touch, *but I could perceive none*. It is true the thin line of light broke up into pieces immediately before extinction; but I remarked that it was precisely where the remarkable prominences were situated that these 'beads' appeared, and I could perceive no phenomena in them which the projection of these mountains would not explain.

Total Obscuration	3 ^h 13 ^m 6.8 ^s	Watch	} Instantaneous and well observed.
Reappearance ...	3 16 26.0	—	

"Clouds came on and the end of the eclipse could not be observed.

"The watch at the time of the eclipse was fast on Greenwich $5^m 57^s$, and slow on the place $43^m 11^s$. This error is deduced from altitudes of the sun on the 29th and 30th, in addition to others taken on the 27th. The result is checked by two other good watches, and can scarcely be wrong more than 1^s or 2^s .

"At $3^h 4^m$ the landscape became strikingly pale, the shadow of the house and of other objects contrasted but feebly with the sunshine." During the totality, "on withdrawing my eye from the telescope, I could neither see the seconds hand of my watch nor the paper sufficiently to write the time down, but had recourse to a candle. Probably the suddenness of the gloom, not giving time for the expansion of the pupil of the eye, increased the sensation of apparent darkness, as I was obliged to repair close to the candle for the requisite light."

On looking at the moon with the naked eye, she appeared neither very round nor very smooth, but as if rudely cut out with a jagged outline. "The corona itself was perfectly concentric and radiating, some of the rays appearing *longer* than the rest, but the irregularity was not great. I was greatly surprised at the light of the corona, to which I should be almost inclined to apply the term brilliant, and I think it was sufficient to account for the light on the sky and landscape. Vaguely, I think the corona gave nearly as much light as the full moon." There was some haze, which obscured *Mercury*, but *Venus* was seen. But for the haze, probably the first magnitude stars would have been visible, as the darkness seemed greater than midnight had done at Christiania.

As soon as the heat from the sun had become sufficiently reduced, Mr. Lassell gave his telescope its full aperture, and applied a power of 43; the totality, and the observations which succeeded totality were observed with the whole of the object-glass. After noting the general appearances as presented to the naked

eye, Mr. Lassell looked for the “red flames” which he had heard described as but faint phenomena. “In the middle of the field was the body of the moon, rendered visible enough by the light of the corona, attended by apparent projections behind her” (a conical-shaped mass at about 90° ; a sort of horn at 270° curved upwards,* with a detached mass just above the point; and two other conical masses at 290° and 315°). “The prominences were of a most brilliant lake colour, a splendid pink, quite defined and hard. They appeared to me not quite quiescent, but the moon by her movement might cause an idea of motion. They were evidently belonging to the sun; for, especially on the western side, I observed that the moon passed over them, leaving them behind, and revealing successive portions as she advanced. I observed only the summit of *one* on the eastern side, though my friends in the adjoining rooms had seen two. The moon had covered one, and, probably, three-fourths of the other, while I was engaged in registering the time and making my observations with the naked eye. The principal flame (that which is figured in the plate No. 8), as I judged, was a few degrees south of the place where the cluster of spots was situated, and the flame on the eastern limb corresponded almost exactly with the place of the eastern spot. As, however, some prominences appeared on parts of the sun’s limb not traversed usually by spots, the connexion between the two is not made out.” By a rude estimation Mr. Lassell thinks that the principal prominence may have been about $2\frac{1}{2}$ in length.

Observations by Mr. Williams.

Mr. Williams observed with a telescope of $2\frac{3}{4}$ inches aperture, and 42 inches focus, fitted with a micrometer. He lost several dark glasses, which he had been the habit of using for the last five years, by the intense heat of the sun.

First Contact $\overset{h}{2} \overset{m}{53} \overset{s}{48}$ Mean Time at Place.

“The light began to wane perceptibly when about nine-tenths of the sun’s disc was covered. With a power of 110 the mountains on the moon’s limb were visibly defined upon the sun’s disc; their position was chiefly south of the moon’s centre and towards the southern cusp. As totality approached, the sun’s uneclipsed limb presented the appearance of a most brilliant golden thread, of a segmental form; this instantaneously broke up into beads and strings of light, presenting the phenomenon known by the name of ‘BAILY’S beads.’ These were observed on the southern cusp *only*, and in positions corresponding with those of the mountains seen on the moon’s limb. The phenomenon seems clearly accounted for by the sun’s rays shining through the valleys between the mountains in the moon.”

The duration of the “beads” might be four or five seconds; when they had disappeared, the corona and red prominences became

* In an inverting telescope.

visible. The corona shone with a feeble light, perhaps equal to one-third that of the full moon. It was divided by radial lines, and presented the appearance of luminous brushes shot from behind the moon. It extended about one-third of the moon's diameter from its edge.

Mr. Williams saw "two conical red prominences (at about 90° and 100°) on the following or east limb, subtending about $38''$ by the micrometer. As the moon advanced, she speedily covered these. On the preceding, or western limb, three prominences were visible." One (at 325°), like an inverted cone, the apex towards the sun: it resembled fire violently shot forth from an orifice. The appearance of the second (about 280°) (see fig. 9) was wonderful beyond description. After ascending vertically, with respect to the sun, a vast height, it bent off to the south nearly at right angles, extending itself to almost an equal distance in that direction." As the moon progressed and left it behind, this prominence increased in size and brilliancy; it resembled fire, the edges were not well defined, especially towards the extremity, and it seemed surrounded by vapour, which was most perceptible towards the extremity. By the micrometer its height was found to be $1' 41''$. Another prominence was seen (about 270°), which also resembled fire; it was smaller but better defined than the two just described.

During the totality *Venus* was seen with the naked eye; but other planets and stars were probably obscured by a thin film of clouds. The largest red prominence was also visible by the unaided eye. The corona was not so well marked as through the telescope. Both the corona and the red prominences disappeared at the first rays from the sun. Clouds soon afterwards collected, and the last contact was completely hidden.

Next day a spot made its appearance on the following limb, just where the more southerly of the two red mountains had appeared. The coincidence of these two spots with the two prominences seen on the following limb, and of the large and remarkable prominence on the preceding limb with the large spot at that place, seems to deserve attention.

Observations by Mr. Stanistreet.

Mr. Stanistreet used a telescope of $2\frac{3}{4}$ inches aperture and $3\frac{1}{2}$ feet focus, by Dollond, with a power of 80.

First Contact $2^{\text{h}} 53^{\text{m}} 45^{\text{s}}$ Local Mean Time.

During the progress of the eclipse, several depressions and eminences were observed on the advancing limb of the moon: one mountain was pre-eminent. The spots on the sun were observed as already described. At $3^{\text{h}} 45^{\text{s}}$ the day became perceptibly darker, and at $3^{\text{h}} 55^{\text{m}} 50^{\text{s}}$ local mean time the moon came in contact with the eastern spot. "While noting the time I observed the light diminish with awful rapidity, and it seemed as if a great pall of shadow was descending upon the earth." Mr. Stanistreet's ac-

count of the phenomena of "BAILY'S *beads*" corresponds precisely with that of his companions; "no beads were observed at that portion of the crescent where the moon's limb was free from any sensible projection."

The corona was formed at the instant of total obscuration, and several bright pink prominences were immediately observed on both sides of the moon. The colour was that seen on the edge of a sunlit cloud at sunset, being of a bright crimson, or, rather, rose hue.

Mr. Stanistreet saw and noted a red prominence on the following limb (at about 85° or 90°), and thinks he remembers another (at about 95° or 100°), but cannot assert this positively. On the preceding limb he saw three, which were apparently in contact with the moon's limb. These are nearly in the places assigned to them by Mr. Williams, but above the remarkable prominence, he saw "a small cloud-like mass apparently detached from the moon." The remarkable prominence he describes "as curved, like a man's arm. It appeared to alter its shape rapidly, unfolding more and more of the curve as the phase proceeded." (See fig. 2). Just previous to the sun's reappearance the height was measured by the micrometer, and found = $1' 42''$.

Mr. Stanistreet states, that the darkness was so great that, "having attempted during the totality to mark the places of the prominences upon a card on which a circle of 4 inches was drawn strongly with Indian ink, the pencil-marks were afterwards found at some distance from the circle, and utterly useless for the purpose intended."

That the motion of the moon was relative to the prominences, uncovering on one side and covering on the other, Mr. Stanistreet agrees in opinion with Messrs. Lassell and Williams. He could only see *Venus*. He calls attention, with Mr. Williams, to the coincidence of the prominences and the spots.

LILLA EDET, on the Göta River.*

Latitude, $58^{\circ} 7' N.$; Longitude, $0^h 48^m 32^s E.$

Observations by Mr. Carrington.

The telescope employed in these observations was one by Mr. Simms. It had an aperture of $3\frac{1}{2}$ inches, and focal length of about 4 feet. The power was about 70, and a slide, containing the coloured glasses, moved in a groove at the end of the eye-piece.

Before the eclipse commenced, the spots were noted and referred to the vertical. The shade, which proved most convenient, gave the sun a pale green colour. The moon's preceding limb, projected on the sun, was very rugged. The cusps seen through the telescope, were always perfectly sharp and well formed, with

* Mr. Carrington was in company with Mr. G. P. Bond, but they separated on the day of observation to improve the chance of success. Mr. Bond's account is expected, but not yet received, as he was unable to draw it up before his departure for the United States. Mr. Carrington's account is printed for private distribution.

one exception at about $3^h 45^m$ local mean time, when there was, for about a minute, a manifest indent in the moon's outline, a little within the southern cusp.

There was no trace observed of the moon beyond the sun at any time during the eclipse. The gloom came on insensibly at first, but latterly very rapidly; it was murky and unusual in kind.

At the disappearance of the sun, "for a short time, the portion of light remaining appeared of uniform width, with sharp cusps; without any notice it flew into numerous little lines, these lines contracted into dots, some again breaking up, the dots contracted and the sun was gone. . . . At the time, the ruggedness of the moon's limb seemed to account for the breaking up of the light; but a recollection of the great regularity of size and arrangement of the dots, which is strongly impressed upon my memory, goes greatly against such an opinion."

A rapid glance at the sun, while taking off the slide of dark glasses, showed the corona, "which was a pure white, brightest next the moon, and insensible at a distance of one-fifth of her diameter: it blended into the sky in one shading off." A star was hastily seen, a very palpable object, which might be *Mercury* or *Regulus*. Immediately afterwards a small pink prominence was seen at an angle of about 100° from the vertex towards the east; it was of the form of a haycock, and rapidly diminished: in 10^s it was gone. Directing the telescope all round the moon, three other prominences were seen; one, also of a haycock form, at about 45° from the upper limb towards the west, and two others at 120° and 130° in the same direction. The colour was pink, tinged with white. The appearance of the two last-mentioned was so remarkable (see fig. 12), that Mr. Carrington confined his attention to them. They evidently increased in size as the moon advanced, and the change is fully accounted for by the successive laying bare of their bases as the moon gradually uncovered them. The appearance of the larger was like that "of a mighty flame bursting through the roof of a house and blown by a strong wind." But though the form was highly suggestive of motion, no change of outline was perceived. The upper portion was curved downwards, almost at right angles to the base. The neighbouring prominence was simpler in form, and, perhaps, a little forked towards the other. "I was greatly astonished by the appearance of five or six *bows of light*, which seemed to connect the summits of these prominences; I noted the colour of the bows as yellow. They maintained their relative position till all vanished. The highest bow was estimated to be $2'$ distant from the moon's limb, and the highest part of the remarkable prominence to be $1'5$, shortly before the end of the totality." (The bows are marked in black in fig. 12).

The thermometer was shaded from the direct rays of the sun by four thicknesses of sail-cloth. It fell from $66^\circ.5$ at $3^h 28^m$ local mean time to 58° at $4^h 22^m$, *i. e.* about 21^m after the reappearance of the sun. Haze came on very rapidly after the reappearance, and increased so much that the end of the eclipse could not be observed.

The degree of darkness during the totality was less than expected. Mr. Carrington could read his watch, which lay at his feet, with a glance; and the title of the "Suggestions," which was hung up at a distance of three yards, was legible enough.

In watching the rose-coloured prominences, Mr. Carrington tried both eyes, and found that they each gave precisely the same appearance.

Observations by M. S. Mygind, Overseer of the Canal at Lilla Edet.

"The darkness during the total eclipse appeared to me not greater than what is usual on a summer's evening in this part of the country in the beginning of July at 11 P.M.

"Directly after the commencement of the totality, a small flame was seen, somewhat crooked, and, as it appeared to me, bending towards west and south, or perhaps south-west—it was of a reddish colour; a smaller one, rather of a round shape, was seen close to it, below." The telescope is non-inverting. M. Mygind's sketch agrees very well with Mr. Carrington's, only the curve is more gradual and like a horn. (See fig. 10.)

Observations by M. L. Svangren.

	Thermometer.		Centigrade.
	Sun.	Shade.	
Before Commencement	+ 23°	+ 17°	
End of Totality	+ 18	+ 13	—

The observations are valuable for their account of the effect upon objects animate and inanimate. Birds seemed terrified, cows and dogs fed as usual. The night violet had its scent greatly increased.

Observations by Dr. J. Boustedt.

"When the eclipse became total there appeared round the moon a bright white ring" (the corona), "which was even, except that it seemed somewhat rugged and more extended towards the left of its upper part."

On the left of the vertex were two red prominences, beyond the limb of the moon, and connected with it; these may be considered at 20° and 60° from the vertex, reckoning towards the east or left. Prominences were seen on the right, in the places noted by Mr. Carrington. Dr. Boustedt's sketch (see fig. 3) is straighter and more gradually curved than Mr. Carrington's. "The upper part of this hook-formed protuberance appeared blue, the lower part rose-red, and fainter in colour at its lower edge. Below this hook-shaped prominence a smaller red spot, *not connected with the moon's limb*, was seen, surrounded with the light of the corona." Another prominence was seen at about 160° from the vertex, measuring towards the west. The prominences, with the exception of the hook-shaped

one and the detached spot, projected from the moon at right angles, and were of a rounded shape.

	Thermometer.		
	Sun.	Shade.	
Beginning of Eclipse	+ 25°	+ 19°	Centigrade.
Totality	+ 17	+ 15°5	—

GÖTEBORG OR GÖTTENBURG, School of Navigation.

Latitude, $57^{\circ} 42' 6'' \cdot 2$ N.; Longitude, $0^{\text{h}} 47^{\text{m}} 50^{\text{s}} \cdot 6$ E.

Observations by Lieut. Pettersson, Director of the School.

The telescope was made by Pistor and Martins, and had an aperture of about 1·9 inches. The commencement was observed with a power of 68, the rest of the eclipse with a power of 40, which gave a field of $1^{\circ} 8'$.

Lieut. Pettersson noted the spots before the eclipse.

First External Contact $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 2 & 53 & 3 \cdot 9 \end{smallmatrix}$ Göteborg M.T.

This determination is considered to be good.

The advancing limb of the moon was strongly serrated.

At about 15^{s} before the totality, Lieut. Pettersson saw, through the red glass which he used as a shade, the continuation of the moon's disc beyond the body of the sun, both above and below the luminous crescent. BAILY'S *beads* were carefully looked for, but not seen.

Beginning of Totality $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 3 & 55 & 52 \cdot 2^* \end{smallmatrix}$ Göteborg M.T.

The disc of the moon was very dark (grey-brown). The corona was composed of rays proceeding from the centre of the double disc which gradually faded away. "Along the part of the moon where the sun disappeared, there remained for some seconds a light of a rose colour, which projected itself on the corona" Lieut. Pettersson saw on the same eastern limb "two *white* flames very near each other. The brighter and smaller, at about 80° from the vertex, was like a short horn turned downwards; the other, much larger and fainter, like a sharpish equilateral triangle, and just above the former." "Other objects on the western limb now drew all my attention. Two prominences of a bright rose colour gave me the notion of a gaseous substance inflamed and projecting outwards. The smaller of these soon seemed to leave the moon's edge, and to float freely in the light of the corona. The other, which was curved towards the former, and much inclined to the edge of the moon, increased with the moon's advance, and finally attained a length which I estimated at $2'$. I observed no change that was not due to the motion of the moon." (The large prominence is about 100° from the vertex, see fig. 5).

"About 5^{s} before the reappearance, I saw along the edge of the moon, just where I expected the sun, a red fringe of rose colour,

* After correcting an error in the assistant's note of time.

on which the remarkable prominence just mentioned seemed to rest, and of which it seemed a part."

End of Totality.....	^h	^m	^s	Göteborg M.T.
	3	59	8.2	
Last External Contact	4	58	2.6	— —

but this was observed with great difficulty on account of clouds.

During the totality Lieut. Pettersson was able to make a sketch of the remarkable prominence without the assistance of a light. He calls attention to the near coincidence of the prominences and the spots.

Near GÖTTENBURG.

Latitude, $57^{\circ} 42' 10''.6$ N. ; Longitude, $0^h 48^m 0^s.4^*$

Observations by the Astronomer Royal.

Among several insulated granite hills near Göttenburg, Mr. Airy selected one called *Hvalås* or the *Whaleridge*, about two or three miles from the town, and rugged at the top, which afforded shelter from the wind.

Mr. Airy was provided with a 46-inch telescope of nearly $3\frac{3}{4}$ inches aperture; a good telescope which shows the mottled appearance of the sun well. The mounting is equatoreal and solid. There were four eye-pieces, and a graduated dark glass consisting of two wedges of red and green glass, separated by a wedge of colourless glass with the angle the contrary way. This combination exhibits the sun's disc with a yellow tinge. Lieut. Pettersson supplied Mr. Airy with a good box chronometer beating half seconds.

Two spots were seen on the sun, one macula near the eastern limb of considerable size, and close upon the western limb there was a chain of small maculæ.

Time by Watch.†

First Exterior Contact	^h	^m	^s	Probably 4 ^s or 5 ^s late.
	2	4	2	

During the progress of the eclipse, the extremely mountainous outline of the moon's disc was remarked. About a quarter of an hour before totality, *Venus* shone with much brilliancy. At $2^h 52^m$ by watch, the flame of a candle was visible at 2° angular distance from the sun. A power of 34 was now applied to the telescope. "With this I saw the mountains of the moon perfectly well. I watched carefully the approach of the moon's limb (a phenomenon which my graduated dark glass enabled me to see in great perfection). I saw both limbs perfectly well defined to the last, and saw the line becoming narrower, and the cusps becoming sharper, without any distortion or prolongation of the limbs. I saw the moon's serrated limb advance up to the sun's, and saw the light of the sun glim-

* Deduced by Lieut. Pettersson from a triangulation connecting the station with the Navigation School at Göttenburg.

† Chronometer *slow* on Göttenburg M.T. $0^h 48^m 6^s.55$.

mering through the hollows between the mountain-peaks, and saw these glimmering spots extinguished, one after another, in extremely rapid succession, but without any of the appearances which Mr. Baily has described. I saw the sun covered, and gave the signal for time, which was taken from the chronometer at $3^h 7^m 50^s$; and, in spite of the difficulty of reading, to which I shall allude, I have no doubt that this register is correct; as my excellent assistant, Mr. Hasselgren, had kept his eye carefully fixed on the chronometer, and was listening to its beats."

Slipping off the dark glass the corona was immediately visible; in Mr. Airy's drawing, the rays, or rather bundles of rays, are very strongly marked. The corona was far broader than that which Mr. Airy saw in 1842; its breadth was little less than the moon's diameter, the structure radiated, and it terminated, though very indefinitely, in a way which reminded him of the ornament placed round a mariner's compass. The colour was white, like that of *Venus*. No flickering was sensible, nor any annularity of structure. The darkness struck Mr. Airy as more profound than in 1842; the chronometer could not be read without a candle, nor could pencil-marks be seen until after a very near approach to the lantern.

The red prominences were very remarkable. Mr. Airy has given three drawings of their appearances. At the first view, there was a conical prominence seen at about 80° from the vertex to the east, and one, a very odd-looking one, about 90° to the west. This is shaped like a *bomerang* with the extremity downwards. A little below the *bomerang* was a small protuberance adhering to the sun, and yet a little farther below, a detached cloud or balloon, nearly round, and separated from the moon's limb by the corona. (See fig. 1.)

In the second view, the eastern spot had disappeared, the moon having overlapped it, and the two on the west, which touched the moon, were lengthened, the moon evidently having uncovered more of their bases: the detached portion was farther removed from the moon's limb. And now a conical prominence came into sight, at about 60° to the west, measured from the vertex.

In the third view, just before the sun reappeared, all these objects were still further lengthened, from the moon's motion as before mentioned; and a *sierra*, or range of serrated eminences, came into view, extending from 135° to 165° , measured from the vertex towards the west, nearly where the sun reappeared. This *sierra* is seen in the drawing representing Mr. Dawes' sketch, which contains a second *sierra*, almost in prolongation of this.*

The colours of the prominences seemed to have varied somewhat, but to have been vivid in the oddly shaped one, and generally brighter on the edge. The *sierra* was a full colour, nearly scarlet.

* The angles are guessed from the sketches, which, as the sketches were made from hasty reminiscences, is near enough for the purpose of *illustration*,—all that is intended in this Notice.

End of Totality $3^{\text{h}} 11^{\text{m}} 6^{\text{s}}$ by the watch.

When the sun reappeared, Mr. Airy's eye was caught by a duskiness in the south-east, the eclipse shadow in the air travelling away in the direction of the shadow's path. This shadow remained in sight at least 6^{s} , and was far more conspicuous than was expected.

The sky became gradually thicker, and it was almost impossible to distinguish the sun's limb.

Last Contact $4^{\text{h}} 9^{\text{m}} 51^{\text{s}}$ by the chronometer; very uncertain.

the correction of the watch being as before $+0^{\text{h}} 48^{\text{m}} 6^{\text{s}}.55$.

Time by Chron.	Thermometer in Shade.
$2^{\text{h}} 14^{\text{m}}$	64.4° Fahr.
$2^{\text{h}} 25^{\text{m}}$	63.0
$2^{\text{h}} 59^{\text{m}}$	60.9
$3^{\text{h}} 58^{\text{m}}$	58.2
At the end.	61.0

From accounts given to Mr. Airy, he conceives that *Mercury* and *Regulus* were seen at Göthenburg.

Latitude, $57^{\circ} 43' 5''$ N. ; Longitude, $0^{\text{h}} 47^{\text{m}} 49^{\text{s}}.1$ E.

Observations by Mr. W. Swan, and Mr. E. W. Lane.

Mr. Swan employed a good telescope of 2.1 inches aperture, and 31.5 inches focal length, magnifying power about 28 . The dark glass was a coloured prism, achromatised by a colourless glass, which made the sun appear yellow with a slight tinge of green.

The times were taken by a box chronometer, lent by Lieut. Pettersson of the Navigation School, and rated by him on his own standard chronometer. Though there was a little thin cloud over the sun, the definition was remarkably good, until the totality was over. "During the progress of the eclipse, the cusps continued quite sharp until the sun was reduced to an extremely narrow crescent of 90° or less in extent, when they were sensibly rounded. This appearance became more and more decided, until at length the moon's limb was quickly joined to the sun by numerous thick lines which occupied nearly all the remaining crescent of the sun. The spaces between the lines were at first rudely rectangular, but gradually became rounded, so as to resemble a string of bright beads, after which they finally disappeared. The same phenomena were seen in a reverse order after the total phase, but the beads were less numerous than before."

Immediately after the disappearance of BAILY's *beads* the sun was viewed with the naked eye and the corona was seen fully formed. "The darkness at first seemed very great, owing to the contrast of recent sunshine, and Mr. Lane found a candle necessary

for reading the chronometer. . . On looking through the telescope, having removed the shade, the first object which attracted my attention was a remarkable hook-shaped red prominence at $110^{\circ} 30'$ to the west of the sun's vertex, and immediately afterwards I saw another red prominence, with a serrated top, resembling a chain of peaked mountains, at $132^{\circ} 40'$ west of the sun's vertex. The hook-shaped prominence was somewhat like Eddystone light-house, if you conceive the top beginning to fuse, and bent over like a rod of half-melted glass."

These prominences increased in height as the eclipse advanced, "evidently owing to the gradual disclosure by the moon of those parts which were nearest the sun." They were of a full rose tint, and were distinctly visible to the naked eye.

"The corona cast no sensible shadow. Seen in the telescope its colour was silvery white. It was distinctly radiated, and showed no trace of annular structure. Brilliant beams of light shone out in various directions to some distance beyond the general outline of the corona. A conoidal mass, with somewhat concave sides, and its base to the sun, was remarked at $28^{\circ} 30'$ from the vertex towards the east."

Observations of spots of the sun, and of the red prominences observed by Mr. Swan.

	Göttenburg M.T.		Angle from Sun's Vertex.	
	^h	^m	^o	[']
Group of Spots 1' from Limb.....	1	37	96	30 W.
Single Spot 1' from Limb	1	40	62	0 E.
Hook-shaped Prominence	3	8	110	30 W.
Serrated.....	3	8	132	40 W.
Brightest Rays of Corona	3	8	28	30 E.

Phases of the Eclipse.

	Göttenburg M.T.			
	^h	^m	^s	
First External Contact	2	53	4.4	about 2 ^a late
Beginning of Totality	3	55	52.6	
End.....	3	59	8.1	
Last External Contact	4	57	57.8	Probably too late

Meteorological Observations.

Göttenburg M.T.	Dry Thermometer.	Wet Bulb.
^m 2 45	^o 66 Fahr.	^o 60 Fahr.
4 10	57	55
4 55	62.3	59.1

Mr. Swan made his observations in *position* with a micrometer of rudish construction, but sufficiently exact for his purpose. The tube carrying the eye-piece had two arms, in contrary directions, fixed upon it, each of which was furnished with a spring pointer. The tube through which this passed had upon it a disc of flat brass, covered with a disc of card. The card disc is immoveable, while the eye-tube with its pointers turns freely round. There are

three equidistant wires in the eye-piece, the two outer wires being just equal to the moon's diameter. When, therefore, these embrace the moon's disc, the middle wire passes through her centre. It is easy in this way to prick holes in the card corresponding to the direction of the wires; and if the centre wires are tangents to the moon, and the middle wire passes over any spot or prominence, the direction of the wires will correspond to the position of the spot, &c., referred to the moon's centre. Mr. Swan seems to have had a telescope with a horizontal and vertical motion, and he adjusted his zero by a level; all his measures refer to the sun's *vertex*. With an equatoreal the process would be much simpler.

Observations by Mr. John Adie, at the Hotel Götha Kellare.*

The telescope had an object-glass of 1·6 inches aperture, and 10·75 inches focus, with an erecting eye-piece, power 15 : it was held in the hand, but steadied by a support.

"At 3^h 35^m Göteborg M.T., the moon appeared to have a narrow sharp band, intensely black, round the whole portion of her disc seen projected on the sun; while, within this black band, a portion of the body of the moon appeared illuminated, and of a greyish white colour. At 3^h 40^m I saw distinctly a portion of the moon's edge beyond the part projected on the sun, and I estimated this to extend to about 8° round the moon's circumference from each point of the cusps."

The most remarkable of the rose-coloured prominences was that on the western limb about 100° from the sun's vertex. When first seen, it had the form of a half-crescent moon, with a rich rose colour at the edges, and fading into a more yellow hue towards the centre. Its estimated altitude was 1½ when first seen. A little south of this, and opposite the point of the crescent, there appeared an irregular mass of the same colour, perfectly detached from the crescent and from the body of the moon; it appeared suspended in space (see fig. 8). Two other rose-prominences were seen, one at 135° from the vertex to the west, and the other at 95° to the east, 2' high, perhaps. As the moon advanced, the crescent-shaped prominence increased, till it was perhaps 3' high. The eastern prominence diminished one-half. There was no relative change observed between the neighbouring rose-coloured prominences, nor any instability or wavering about their colour or intensity. They became visible at the disappearance of the beads, and were blotted out at the moment of their reappearance.

The corona was brightest near the sun, and extended about one-third of the moon's diameter; of a soft silvery white, with brighter coruscations shooting through it beyond the general light, which gave it a flickering appearance. Over a space of 30°, measuring from the sun's vertex to the east, these coruscations extended to about two-thirds of the moon's diameter, and this space was the

* Taken from Mr. Adie's published account.

brightest throughout. The moon's surface seemed to have a faint greyish light over it.

Mercury and *Venus* were visible, and *Jupiter* was said to be so. Bright stars were looked for, but the sky was too cloudy. The colour over the landscape was of a bluish-black livid hue. The amount of light during the greatest obscurity was estimated at about half moonlight. The hour and minute hands of the watch were visible, but not the seconds' hand, nor the minutes on the dial.

Observations by the Rev. Temple Chevallier.

The position taken by Mr. Chevallier was an elevated platform on the top of the *Götha Kellare* Hotel, about $2\frac{1}{2}$ miles N.W. of the hill where the Astronomer Royal was stationed. The telescope, by Ross, was one presented by the late Duke of Northumberland to the Durham Observatory, aperture 5 inches, focal length 7 feet 2 inches, power 180. This was mounted equatorially on a temporary stand, and would have been sufficiently steady in a less exposed situation. The dark glass consisted of a wedge of red glass combined with colourless glass, in the manner recommended in the "Suggestions." A diaphragm, to limit the aperture, was used for the first half hour after the beginning. The first external contact was lost. At $2^h 55^m 7^s.1$ Göttenburg M.T., the moon eclipsed the darkest part of a spot upon the north-western edge of the sun. Very marked prominences were observed upon the moon's edge, one of which was estimated by Mr. Chevallier to subtend an angle of $50''$.

When the sun was two-thirds eclipsed, the light near the middle of the disc of the sun was estimated to exceed the light of his edge, in the proportion of 3 to 2.

Just before the totality commenced, the moon eclipsed a spot upon the N.E. edge of the sun at $3^h 55^m 7^s.9$ M.T. As the field of the telescope would only take in a portion of the sun, Mr. Chevallier directed his attention to the upper cusp. "The light was there less bright than elsewhere, and the whole cusp was more like a liquid than a solid. As the cusp became narrower, the light had a fluctuating motion, and seemed to fail by running along the sun's edge, trickling away like drops of quicksilver down a narrow groove, so as partially to interrupt the continuity of the rim of light; but not so as to form any fixed bounds of alternate light and darkness."

Beginning of Totality $3^h 56^m 54^s.9$ Göttenburg M.T.

"To the naked eye, the moon appeared as a black spot surrounded by its luminous corona, the radius of which was about a sixth part greater than the radius of the moon." Mr. Chevallier saw *Venus*, but did not look for *Mercury*: *Mercury*, *Jupiter*, and *Regulus*, are said to have been seen at Göttenburg by others. "The hills from 6 to 10 miles distant were distinctly visible, and

during the whole obscuration, the figures on the face of the chronometer and pencil-writing could be read."

Mr. Chevallier then directed his attention to the opposite side of the moon, that from which the sun would emerge, and observed three bright prominences. "That which was the lowest was a pink protuberance, the base of which was about $\frac{1}{2}'$ wide, rising to a single peaked ridge about half the height of its base. The form of this changed but little. The two others (see fig. 11) above this were much higher and larger. Each rose from a narrow base, and with a waving outline, extending in the upper part into a long flag-like position, tinged at the edge with a delicate pink colour, brighter than the other parts. Their appearance was that of high clouds, brilliantly illuminated at sunset." Careful inspection showed "that the objects were certainly connected with the sun, for the separation of the edge of the moon from them, as she moved onwards, could be distinctly seen." The height of the largest, at about 1^m before the end of the eclipse, was estimated at $1' 12''$. "As the eclipse advanced, the light from behind the moon became like the brightest twilight, rising higher and higher above the moon's surface, and forming a brilliant red edge, until it was effaced by the reappearance of the dazzling white light of the sun."

The corona cast no shadow, and the shadow cast by a wax taper in a lantern was invisible, when the taper was 193 inches from the screen.

The shadow cast by the same taper at 152 inches from the screen was found by Mr. Chevallier to be equal to the shadow cast by the moon on November 3, 1851, when she was 10 days old, and had past the meridian one hour, shining very brightly. The shadow cast by the taper, where there was no extraneous light, was very faint at 576 inches, but was discernible at 828 inches.

It would seem that the sky during the total eclipse was considerably brighter than in ordinary moonlight.

Mr. Chevallier furnishes the following account by an observer who accompanied him. The telescope used was a clearly defining astronomical telescope,—aperture $1\frac{1}{2}$ inches, focal length 18 inches, power about 10. When the sun was a good deal hidden, there was nothing of the dark limb of the moon seen.

As the sun disappeared, four black bands were seen which crossed the fine crescent.* "The moment it became dark, the corona appeared. It was of a pale yellowish colour; a bright ring about one-seventh of the moon's diameter nearest the moon; and light rays of the same colour branching out all round beyond this, to rather more than half the moon's diameter. The limit of the bright ring was distinct; but the rays faded away so as to leave no definite edge to the outer part. It was very bright where the sun had disappeared, and was darker where the sun afterwards reappeared. The corona was of the same breadth all round, and

* The illustrative drawing represents these bars as being very much like the phenomena described by Bailey, fig. 3.

was very well seen and examined by the naked eye. There was light enough to make and read pencil notes without difficulty, the paper being laid on the table. *Venus* and *Mercury* were quite bright."

At the reappearance, the same black bars, across what seems to have been the narrow crescent of the sun, were seen as before. As the sun advanced, these bars became narrower and narrower, and, finally, quitted their hold altogether. The appearance is compared to that shown by a piece of thin India rubber, when it is torn in two, and little pieces give way before the rest. "The edge of the sun had a totally different appearance in coming out and in going in. Then, it was a definite, smooth portion of a circle; now, one part appeared first, then a little bit somewhere else, and it seemed to be 2^s before it assumed the appearance of a limb intersected by bars, and 3^s more before these bars quite disappeared."

"Distant objects and the outlines of the hills were quite visible during the darkness."

RAVELSBERG, 1 mile N.E. of ENGELHOLM.

Approximate Latitude, 56° 16' N.; Approximate Longitude, 0^h 51^m 33^s E.

Observations by Mr. Hind.

Mr. Hind employed an excellent telescope by Dollond 1½ inches aperture with a magnifying power of about 20.

First Contact 3^h 0^m 18^s Local M.T.; only approximate.

At 3^h 40^m, the first indication of colour in the moon. She appeared of a dull coppery red, and her outline could be traced all round. No spots on the moon's surface were visible, but the limb was exceedingly rough, especially one gap near the southern cusp. The definition was excellent throughout.

"Shortly before the commencement of totality, a large mountain close to the south cusp suddenly appeared to shoot forward and connect itself with the sun's limb, leaving a very small lunular portion of his disc visible south of the bright crescent; a few seconds later, the same appearance was noticed in respect to other irregularities on the moon's limb, and BAILY's *beads* were formed. The remaining portion of the sun's illuminated disc presented something of the appearance of a string of luminous beads, *but of irregular size and shape*; the largest corresponding to the gap or valley near the south cusp, already mentioned. It was impossible, in viewing the phenomenon under the most admirable sharpness of vision I ever witnessed, to avoid the conclusion, that Baily's beads are caused by the sun shining along the valleys, and between the mountain ridges on the limb of our satellite, the effect being greatly aided by irradiation."

Five seconds after the totality commenced, the corona was looked for and seen conspicuously. Its colour was that of *tarnished silver*, owing perhaps to the intervention of a thin cloud. The breadth of

the corona was about one-third of the moon's diameter. Rays of light extended through and beyond it, but no trace of circular motion. It was visible on the western side for at least 5 seconds after the sun reappeared.

After the totality commenced, "three rose-coloured prominences immediately caught my eye, and others were seen a few seconds later. The largest and most remarkable was situated about 5° north of the parallel of declination on the western limb (275°):" it was straight throughout two-thirds of its length, and curved, like a sabre, near its extremity; the concave edge towards the horizon. The edges were of a full rose-pink; the central part a paler pink. About 20^s after the disappearance of the sun, I estimated its length at $45''$; towards the end of the totality it was perhaps $2'$; the moon having apparently left more and more of it visible as she travelled across the sun. I perceived no change of form or motion, and it was visible 4^s after the sun reappeared, but detached from the sun, the strong white light of the corona being visible between it and the sun." (See fig. 6 and Mr. Dawes' sketch).

A triangular detached spot of the same colour was seen suspended in the light of the corona about 10° to the south (at 265°). The moon moved *away* from this detached portion, which preserved its relative position to the sabre-like mountain. "On the south limb of the moon (from 150° to 240°) appeared a long range of rose-coloured flames, which seemed to be affected by a slight tremulous motion. The bright rose-red of the tops of these prominences gradually faded towards their bases, and in their place a bright narrow line of a deep violet tint appeared along the moon's limb. In this range there was, towards the western end, one eminent projection (about 210°), and one of a similar form and size at 145° . These might be about $40''$ high." Mr. Hind's drawing corresponds very well indeed with that of Mr. Dawes.

The surface of the moon was reddish purple at the beginning of totality, which changed to a dull purple. A bright glow, like twilight, indicated the place where the sun was about to emerge. Three or four seconds later, the beads again formed, instantaneously, but less numerous and more irregular than before. In about 5^s more, the sun appeared as a fine crescent, and the *beads* were suddenly extinguished. Ten minutes later, the sky clouded up.

During the totality, the corona seen by the naked eye was by no means brilliant. The darkness was not like that of night; the landscape seemed to be overspread with a dark olive tint; yet distant objects seemed visible at a greater distance than they would be under the same degree of darkness in the evening.

Observations by Mr. Dawes.

Mr. Dawes observed at the same place with Mr. Hind, but the observers kept themselves clear of all communication during the eclipse.

Mr. Dawes used an excellent achromatic by Dollond, aperture 1.6 inches, and focal length 22 inches. The eye-piece principally employed magnified 29 times, with a field of about $1^{\circ} 36'$. The

movement was equatoreal and steady. In the centre of the field of this eye-piece were two stout spider-lines at right angles to each other, and a wire, subtending an angle of $58''$ in thickness, also crossed the field parallel to one of the spider-lines, and at some distance from the centre of the field. The only spots seen were a small group, about $1'$ or $2'$ from the western edge of the moon, in the north-west quadrant, and another very near the eastern edge, at about 88° .

First Contact $3^h 0^m 16^s$ Local Time,

Excellently observed, but the error of the watch only approximately known.

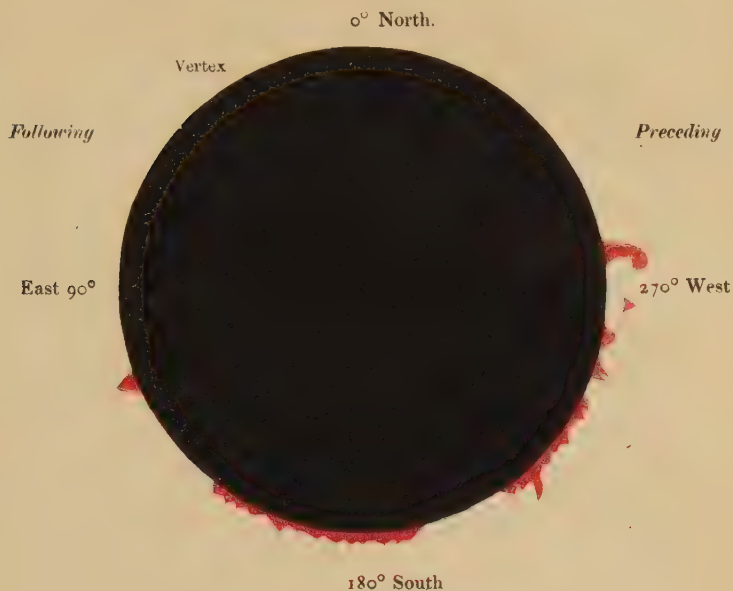
"The moon's advancing limb was seen to be extremely uneven. A remarkably large mountain was noticed about 15° of the moon's circumference to the south of the point of first contact."

At $3^h 54^m$ a light cloud covered the sun without apparently injuring the definition; at $4^h 1^m$ the light in the field of the telescope was remarkably blue. Repeated and varied attempts were made to ascertain whether the edge of the moon was illuminated, "*but no illumination of the moon's limb was ever perceived.*"

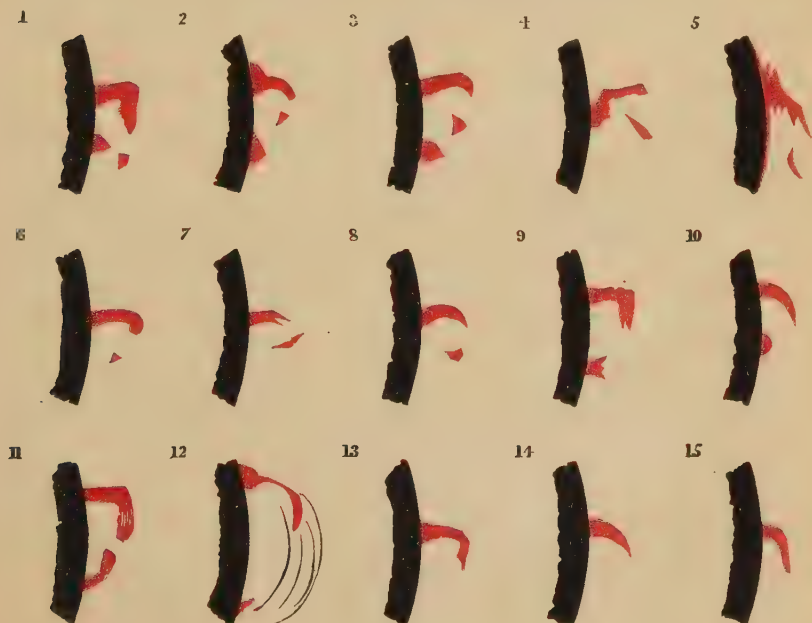
"About one minute before the disappearance of the sun, a portion, perhaps $1\frac{1}{2}$ in length, was separated from the rest of the very narrow crescent at its southern extremity, by the protrusion of a remarkably large mountain in the moon's border. In a few seconds afterwards, a very small piece at the point of the same cusp was separated from the portion already cut off. About 3^s or 4^s before the totality, the fine crescent was broken up into numerous pieces or *beads*, I think about eight or ten; but they did not all appear at the same instant; they were not round, and were very unequal in length, *the dark intervals between the bright portions corresponding exactly with the positions of the mountains on the moon's edge, and evidently caused by them.* These intervals were largest towards the southern extremity of the crescent. I was particularly struck with the fact that the lunar mountains broke through the crescent, while it yet appeared to be considerably broader than the extent of their own projection beyond the general outline of the moon's circumference. This was very observable in the case of the largest of them, which divided the crescent so long before it seemed capable of doing so, as to take me quite by surprise. The lunar mountains had thus the appearance of *being drawn out into narrow black threads*, reaching to the exterior edge of the sun. This curious phenomenon I attributed, on subsequent reflection, to the effect of irradiation, which, increasing the apparent breadth of the brilliant narrow crescent, consequently increased to the same extent the apparent length of the prominences which broke through it."

The corona did not show itself instantaneously to Mr. Dawes on the disappearance of the sun, which he supposes might be owing to a short insensibility of the retina, as he observed the disappearance of the beads without a dark glass. It appeared in about 1^s or $1\frac{1}{2}$ after the totality. The extreme breadth of the corona was about

Total Eclipse, July 28, 1851, from Mr. Dawes' Sketch.



Remarkable Prominence, as seen by different Observers.



half the diameter of the moon, and about one-third of this nearest the sun was much brighter than the outer portion, which gradually faded away. The constitution of the corona was somewhat flocculent, not annular, nor intersected by rays, except towards the edge.

"From 0° to 90° no visible protuberance: at about 115° a large deep rose prominence of a regular conical form was observed: it was perhaps $1\frac{1}{2}$ in altitude at first, but was gradually covered up as the moon advanced; the colour fainter in the middle than on the edge (see the plate, which represents Mr. Dawes' sketch).

"At about 145° commenced a low ridge of red prominences, resembling in outline the tops of a very irregular range of hills. The highest did not probably exceed $40''$. This ridge extended to about 197° , its base was the sharply defined edge of the moon. The irregularities appeared permanent, though there was an undulation from the west to the east, probably owing to our own atmosphere."

"At 220° commenced another low ridge of the same character, extending to about 250° , less elevated and less irregular in outline than the former, except that at about 225° a very remarkable protuberance arose from it; to an altitude of $1\frac{1}{2}$, or even more. This was in form like a dog's tusk, the convex side north and the concave south, and the apex acute. The tint of the lower range was a rather pale pink, the colour of the higher prominence was deeper and brighter."

"A small double-pointed prominence was seen at 255° , and a low one, with a broad base, at 263° . These were of the same colour, but paler, than the height just noticed. At or very near 270° , appeared a bluntly triangular pink body, *suspended*, as it were, in the corona. This was separated from the moon's body when first seen, and the separation increased as the moon advanced."

"To the north of this, at about 280° or 285° , appeared the most wonderful phenomenon of the whole. A red protuberance of vivid brightness, and very deep tinted, arose to a height of $1\frac{1}{2}$ perhaps, when first seen, and increased in length to $2'$ or more, as the moon's progress revealed it more completely. In shape it somewhat resembled a *Turkish cimeter*, the northern edge being convex, the southern concave. Towards the apex it bent suddenly to the south, or, as seen by the telescope, upwards. Its northern edge was well defined, and of a deeper colour than the rest, especially towards its base. I should call it a *rich carmine*. The southern edge was less distinctly defined and decidedly paler. It gave me the impression of a somewhat conical protuberance, partly hidden on its southern side by some intervening substance of a soft or flocculent character. The apex of this protuberance was paler than the base, and of a purplish tinge; and it certainly had a flickering motion. Its base was from first to last sharply bounded by the edge of the moon. To my great astonishment, this marvellous object continued visible for about 5^s , as nearly as I could judge after the sun began to reappear, which took place many degrees to the south of the situation it occupied on the moon's circumference. It then rapidly faded away, but it did not vanish instantaneously."

"The arc from about 283° to the north point was entirely free from prominences and also from any roseate tint."

Mr. Dawes desires not to speak very positively as to the length of the protuberances; besides the difficulty of estimation, they changed in size, owing to the moon's motion. The colour of the moon during the totality was a purplish black. Immediately after the sun's reappearance, the thermometer stood at 57° .

Mr. Dawes counted the beats of his watch from the beginning of the totality till 20^s had elapsed; but on looking at the watch the seconds were not visible. A pencil, which was accidentally dropped upon the ground, was not distinguishable.

"At the reappearance, the interruptions of the narrow luminous line were very few and small; only two or three at irregular intervals were noticed. On examining this part of the moon subsequently, it was found to be free from obvious irregularities.

"The duration of the total obscuration was probably about a minute and a half."

HELSINGBORG, $2\frac{1}{2}$ miles due East of Elsinore Castle.

Lat. $56^{\circ} 4'$ N.; Long. $15^{\circ} 51'$ E. (by map).

Observations by Capt. F. W. Blackwood, R.N., and Lieut. Goodenough, R.N.

The telescope was a good one by Fraunhofer,—aperture 3 inches, all of which was used, power 32. The dark glass was one of neutral tint, which gave a clear image. Time was obtained by altitudes of the sun with a good sextant and mercurial horizon.

At first, the clouds were light and fleecy; but about 2 P.M. they became thicker, and interfered with the observation.

First External Contact at $3^h 1^m 7^s$ Local M.T.; a little doubtful.

The advancing limb of the moon appeared very rough, especially near her *upper cusp*.*

At $3^h 40^m$ the clouds increased, the light was now sensibly diminished, the cusps sharp.

The Totality took place at $4^h 3^m 35^s$ Local M.T.; correct.

A hazy appearance of bright light made its appearance round the whole circle of the moon excepting at the upper part, where for a space of about 70° the limb was surrounded by a narrow crescent of a reddish violet tinge, something like the flame from a coke fire. "There was no *aureole*, or rays shooting out; it was simply a band of white light surrounding the moon." "One red prominence only was seen about 20° to the left of the moon's vertex, and rising to a height of $2'$." "This red prominence had no decided outline; it was wavy and irregular in form, rather like a flame seen through a medium of hot air. (See fig. 4). The sun reappeared too soon to allow of a careful scrutiny of the whole limb, as the totality did not last above 30^s , if so long."

* The description by Captain Blackwood applies to the objects as seen in the telescope which inverted.

Surprise and the early reappearance of the sun prevented the accurate observation of this phenomenon, or of the red prominence. The sun was soon after clouded up.

CHRISTIANSTADT.

Lat. by map $56^{\circ} 4'$; Long. $0^{\text{h}} 56^{\text{m}} 40^{\text{s}}$ E.

Observations by Mr. Humphreys.

Mr. Humphreys, of Caius College, Cambridge, who was formerly an assistant at the Royal Observatory, having offered to assist Mr. Airy in observing the eclipse, was requested to station himself at Christianstadt, on the east of the central line, as a balance to Mr. Dunkin, who was at Christiania, on the west. The position selected was an old redoubt in the drilling-ground, about quarter of a mile W. by N. of the town.

The telescope used was a signal-station telescope, *non-inverting*, power about 25.

First External Contact $2^{\text{h}} 9^{\text{m}} 27^{\text{s}}$ * by chronometer; Arnold, 1790.

The sun was hidden by clouds for about 17^{m} after the first contact, and also for 8^{m} after $2^{\text{h}} 34^{\text{m}}$. After this time, though the sun's disc was occasionally hazy, the observation was not seriously obstructed. When the sun was half eclipsed, the light had diminished sensibly; at $2^{\text{h}} 45^{\text{m}}$, the flame of a candle held up before the sun was visible. At $3^{\text{h}} 0^{\text{m}}$ an irregularity in the moon's limb, like an indent, was observed near the lower cusp. No portion of the moon external to the sun was seen before the totality, nor were any "*beads*" seen; but the last lune of the sun seemed to glisten as it disappeared.

Beginning of Totality $3^{\text{h}} 12^{\text{m}} 4^{\text{s}}$ by chronometer; Arnold, 1790.

The corona seemed now to form all at once, and to be concentric with the sun. It presented the appearance of a succession of annuli, which altogether were half the moon's radius in width. It appeared faintly coloured; and equidistant brushes of light, 6 or 7 in number, of a very light violet, appeared in streamers from the the corona, and converging to a point.

A red prominence was seen at 40° from the vertex towards the east. This was estimated at about $30''$ altitude, and it disappeared very soon. The hook-shaped prominence (fig. 7) showed itself at about 135° from the vertex towards the west. This became longer and brighter as the eclipse advanced; it was curved, with the point downwards, and ended in a double tongue. The height was estimated at $50''$. It was accompanied, a little below the extremity of the hook, by an equally bright and similarly coloured *detached* portion, somewhat like a spider. As the totality continued, two more prominences made their appearance at about 150° and 160° respectively, from the vertex towards the west. These

* The rates of the chronometer between Greenwich, Altona, and the return to Greenwich, are not sufficiently good to allow the times by chronometer to be reduced to Greenwich time.

prominences were of a beautiful rose colour; the southern edges of those which were based on the moon glistened with a white bright light. The detached portion had this appearance on its northern edge, and the white light of the corona separated it from the hook-shaped portion, and from the moon's limb.

A few seconds before the reappearance of the sun, the moon's edge seemed glistening, and there was some doubt whether the sun had not actually reappeared.

End of the Totality $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 3 & 14 & 50 \end{smallmatrix}$ by Arnold, 1790.

For a few seconds after the reappearance, the whole circumference of the moon was distinctly visible, appearing to glitter with a white light.

The last External Contact $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 4 & 13 & 27 \end{smallmatrix}$ by Arnold, 1790.

Thermometer Readings.

	Black Bulb.	Dry Therm.	Wet Therm.
$\begin{smallmatrix} \text{h} & \text{m} \\ 2 & 10 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 75\cdot5 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 69\cdot0 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 60\cdot0 \end{smallmatrix}$
$\begin{smallmatrix} \text{h} & \text{m} \\ 3 & 0 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 66\cdot0 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 64\cdot2 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 57\cdot0 \end{smallmatrix}$
$\begin{smallmatrix} \text{h} & \text{m} \\ 3 & 15 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 60\cdot5 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 62\cdot0 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 55\cdot6 \end{smallmatrix}$
$\begin{smallmatrix} \text{h} & \text{m} \\ 4 & 30 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 71\cdot0 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 65\cdot0 \end{smallmatrix}$	$\begin{smallmatrix} \text{o} \\ 58\cdot2 \end{smallmatrix}$

Observations by Mr. Miland.

Mr. Miland accompanied Mr. Humphreys, and their observations are generally in accordance.

Mr. Miland did not see the indent near the south cusp.

Beginning of Totality..... $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 3 & 10 & 0 \end{smallmatrix}$ by M'Cabe, 194.

End..... $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 3 & 12 & 45 \end{smallmatrix}$

Last External Contact ... $\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 4 & 12 & 0 \end{smallmatrix}$

At $2^{\text{h}} 29^{\text{m}} 30^{\text{s}}$ the flame of a candle was visible before the sun. Some difficulty was felt in reading the chronometer during the totality, and a lighted candle was very gladly resorted to.

The corona, though white at first, appeared afterwards tinted with pale blue.

Observations by Colonel Silverstope.

Some few minutes before the total eclipse the wind fell, and the weather was calm.

By a stop-watch, the duration of the totality was found to be $2^{\text{m}} 41^{\text{s}}\cdot7$.

The corona was light violet, nearly white, and not quite regular, but in parts waved. *Venus* was the only star seen during the total darkness. The increase of light when the sun reappeared seemed to proceed more rapidly than did the decrease. The progress of the shadow over the country could not be seen, only the variation of the light. The eclipse lasted $2^{\text{h}} 4^{\text{m}}$.